

HEALTH SERVICES RESEARCH

Appropriate Telemedicine Utilization in Spine Surgery

Results From a Delphi Study

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Study Design. Delphi expert panel consensus.

Objective. To obtain expert consensus on best practices for appropriate telemedicine utilization in spine surgery.

Summary of Background Data. Several studies have shown high patient satisfaction associated with telemedicine during the COVID-19 peak pandemic period as well as after easing of restrictions. As this technology will most likely continue to be employed, there is a need to define appropriate utilization.

Methods. An expert panel consisting of 27 spine surgeons from various countries was assembled in February 2021. A two-round consensus-based Delphi method was used to generate consensus statements on various aspects of telemedicine (separated as video visits or audio visits) including themes, such as patient location and impact of patient diagnosis, on assessment of new patients. Topics with $\geq 75\%$ agreement were categorized as having achieved a consensus.

Results. The expert panel reviewed a total of 59 statements. Of these, 32 achieved consensus. The panel had consensus that

video visits could be utilized regardless of patient location and that video visits are appropriate for evaluating as well as indicating for surgery multiple common spine pathologies, such as lumbar stenosis, lumbar radiculopathy, and cervical radiculopathy. Finally, the panel had consensus that video visits could be appropriate for a variety of visit types including early, midterm, longer term postoperative follow-up, follow-up for imaging review, and follow-up after an intervention (i.e., physical therapy, injection).

Conclusion. Although telemedicine was initially introduced out of necessity, this technology most likely will remain due to evidence of high patient satisfaction and significant cost savings. This study was able to provide a framework for appropriate telemedicine utilization in spine surgery from a panel of experts. However, several questions remain for future research, such as whether or not an in-person consultation is necessary prior to surgery and which physical exam maneuvers are appropriate for telemedicine.

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The COVID-19 pandemic introduced the necessity for remote work in a variety of occupational settings including orthopedic surgery.¹⁻⁴ Spine care similarly witnessed a rapid increase in utilization of telemedicine,⁵ with usage rising from <10% to approximately 40% of all visits, with the greatest adoption in North America.¹ These telemedicine encounters comprised of various types including audio only or video-based visits.¹ Other than aiding physical distancing efforts, other reported benefits of telemedicine include providing greater access to care for patients and decreasing healthcare costs.^{6,7}

In the United States, the adoption of telemedicine was aided greatly by several waivers granted by the Centers for Medicare and Medicaid Services and subsequently adopted by a majority of private payers. These allowed remote care to be practiced across state lines and improved coverage for telehealth phone and video services.⁸ While the majority of these waivers were issued on a temporary basis, the use of telehealth has proven to be popular with patients and providers, including those within the field of spine surgery.¹⁻³ Spine patients have generally been very satisfied with telemedicine visits and have rated them highly for the clarity of communication, formulation of treatment plans, and the ability to ask questions.⁹⁻¹¹

Due to such rapid introduction of the technology as well as changing medical, political, and legal landscapes, several uncertainties surrounding the optimal utilization of telemedicine in spine surgery persist.¹² Previous studies have shown considerable differences in the definition of telemedicine across geographic regions (e.g., telephone visits *vs.* video visits).³ Such variation has contributed to regulatory and clinical uncertainties and inconsistencies. For example, which visit types are appropriate for telemedicine? Should patients be seen in person prior to surgery? Therefore, the purpose of the current study was to use a consensus-based Delphi method surveying a panel of spine surgery experts to attempt to achieve agreement on these and other important practical considerations regarding best practices in telemedicine utilization for spine surgery. We believe that a consensus obtained from spine surgery experts could serve as a framework for appropriate telemedicine use criteria in other sub-specialties in orthopedic surgery as well as a basis for policy change for telemedicine utilization in regions or countries where such practice has yet to be adopted.

MATERIALS AND METHODS

Expert Panel

A panel of spine surgery experts (Table 1) was assembled by the AO Spine Telemedicine Working Group to discuss various facets of telemedicine as they relate to the care of

TABLE 1. Expert Panel Characteristics

Characteristic	Total = 27
Specialty	
Orthopedic surgeon	22
Neurosurgeon	5
Academic rank	
Full professor	12
Associate professor	6
Assistant professor	6
Not applicable	3
Average years in practice	14.7 years
Practicing country	
United States	22
Saudi Arabia	1
Argentina	1
Finland	1
Hong Kong	1
Egypt	1

spine patients. Overall, 27 spine surgery experts participated. The group consisted primarily of academic orthopedic ($n = 22$) and neurosurgical ($n = 5$) spine thought leaders with varying numbers of years in clinical practice (range: 1–34 years). The majority of the panel consisted of surgeons from the United States ($n = 22$), with international representatives from several other countries included as well ($n = 5$). The panel represented excellent diversity, as both junior and senior surgeons were included from both orthopedic and neurosurgery worldwide.

Consensus-Based Delphi Method Design

We used a consensus-based Delphi methodology. Group meetings were all conducted virtually via videoconference. The initial meeting introduced the goals of the project, which were defined as follows: achieve consensus on the best ways to incorporate telemedicine into spine care. The initial meeting was a structured discussion to identify areas where consensus was needed and clear practice guidelines were lacking. Based on this discussion, five themes were identified and included: (1) impact of patient location, (2) impact of patient diagnosis on assessment of new patients, (3) utility and limitations of the telemedicine physical examination, (4) need for in person visits prior to surgery, and (5) acceptable visit types using telemedicine.

A survey was then constructed to address these themes (Supplemental File, <http://links.lww.com/BRS/B856>). The expert panel sought to focus broadly on five categories of diagnosis: lumbar stenosis, lumbar radiculopathy, cervical myelopathy, cervical radiculopathy, and spinal deformity. For each diagnostic category, the panel sought to differentiate between audio and video telemedicine.

Criteria for Consensus

All statements were surveyed in the first phase of the analysis. A-priori, we defined consensus as follows: all

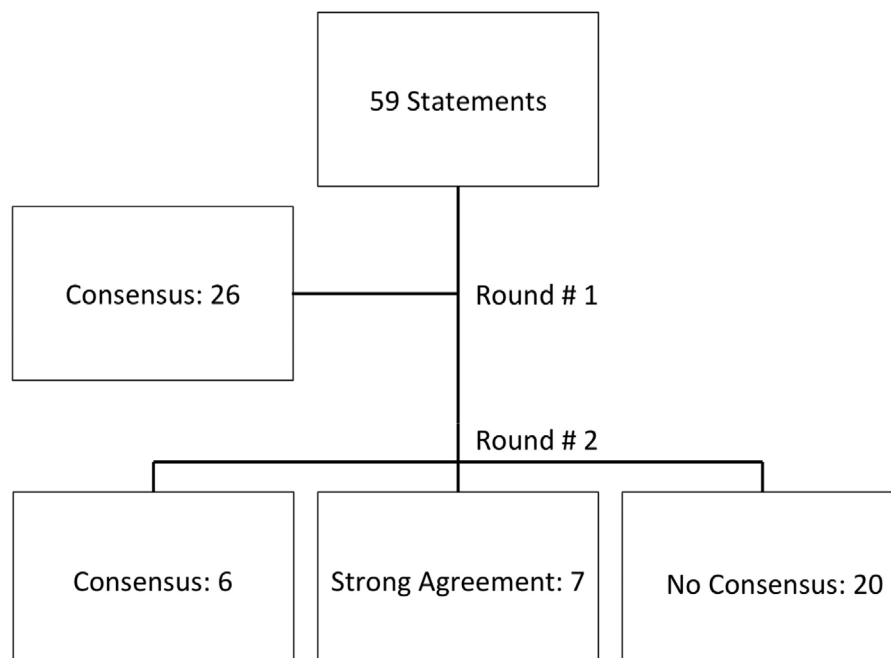


Figure 1. Flow diagram of consensus building process.

topics with $\geq 75\%$ agreement were categorized as having achieved a positive consensus and those with $\geq 75\%$ disagreement was categorized as having achieved a negative consensus. We also considered topics with $\geq 66\%$ to 74% of a single response to have strong agreement/disagreement. Failure to meet any of these thresholds was evidence of no consensus.

The responses with consensus-level concordance during the first round were left unchanged. The survey results were then shared with the group and a second videoconference was held to discuss topic areas where consensus was not achieved. Following this discussion, an abbreviated survey, containing only statements where consensus was not already achieved, was then recirculated to determine if consensus could be reached on any additional areas. A flow diagram of the consensus building process is shown in Figure 1.

RESULTS

Impact of Patient Location

Surgeons were confident in their ability to provide safe and appropriate care to patients located in different state and in different countries using video-based telemedicine (VT) (Table 2, Figure 2). There was more uncertainty about using audio-based telemedicine (AT) for the same purpose; no consensus was reached on this issue. Furthermore, there was strong agreement that the patients' geographic location did not significantly impact the ability of spine providers to deliver appropriate care using telemedicine platforms.

Impact of Patient Diagnosis on Assessment of New Patients

Surgeons had positive consensus on being able to successfully evaluate and indicate patients with lumbar stenosis and

lumbar radiculopathy using VT (Table 3, Figure 2). There was also a strong agreement about the ability to evaluate patients with lumbar stenosis over AT (Table 3).

For patients with cervical spine pathology, consensus was reached that it was possible to evaluate and indicate patients for surgery with cervical radiculopathy using a VT visit (Figure 2). However, consensus was reached that AT was insufficient for the evaluation or indication of patients with cervical myelopathy (Table 3).

Similarly, there was strong agreement that VT might allow for adequate evaluation of patients with spinal deformity for surgery, while consensus was reached that AT was not appropriate for evaluation of patients with deformity (Table 3).

Utility and Limitations of the Telemedicine Physical Examination

Consensus was reached on only two factors related to the physical examination: it was possible to evaluate for gait abnormalities using a video telemedicine visit and that special tests for myelopathy were not possible to perform over a video-based visit (Figure 2).

Need for In-Person Visits Prior to Surgery

With regards to opinions on the need for in-person visit prior to surgery, the expert panel achieved consensus that in-person evaluation prior to surgery is *best practice* for patients who had initial video telemedicine evaluation for cervical myelopathy, cervical radiculopathy, and deformity. There was only strong agreement that this was best practice for patients with lumbar stenosis and lumbar radiculopathy (Table 4). The expert panel had positive consensus on in-person visit prior to surgery is *necessary* after initial video

TABLE 2. Impact of Patients' Location on Ability to Provide Safe and Appropriate Care via Video and Audio Based Telemedicine

Impact of Patient Location on Telemedicine	Yes	No	Maybe
Consensus (>75%):			
Can provide safe and appropriate care to patients located in a different state using video-based telemedicine	89.29%	3.57%	7.14%
Can provide safe and appropriate care to patients located in a different country using video-based telemedicine	82.14%	7.14%	10.71%
Strong agreement (≥66%):			
Patients' physical location does NOT affect ability to provide care using telemedicine platforms	66.67%	29.63%	3.70%
No consensus:			
Can provide safe and appropriate care to patients located in a different state using audio-based telemedicine	55.56%	33.33%	11.11%
Can provide safe and appropriate care to patients located in a different country using audio-based telemedicine	48.15%	33.33%	18.52%

telemedicine evaluation for cervical myelopathy and deformity (Figure 2). There was only strong agreement for cervical radiculopathy with no consensus for lumbar stenosis and lumbar radiculopathy (Table 4).

Acceptable Visit Types Using Telemedicine

The expert panel had positive consensus that VT was appropriate for early postoperative visit (2–6 weeks), mid-term postoperative visit (3–6 months), longer term postoperative visit (>6 months), follow-up visit for imaging review, and follow-up visit after an intervention (*i.e.*, injection, physical therapy) (Figure 2). The panel had strong agreement that a VT visit was suitable for postoperative wound issues (Table 5).

Similarly, the expert panel had positive consensus that AT was appropriate for early postoperative visit (2–6 weeks), mid-term postoperative visit (3–6 months), longer term postoperative visit (>6 months), follow-up visit for imaging review, and follow-up visit after an intervention (Figure 2). However, the panel had negative consensus that an AT visit was suitable for postoperative wound issues (Table 5).

DISCUSSION

The current study provides an important framework, built through consensus statements from a panel of academic spine thought leaders, for the application of telemedicine in spine surgery. Findings of this study have broad relevance

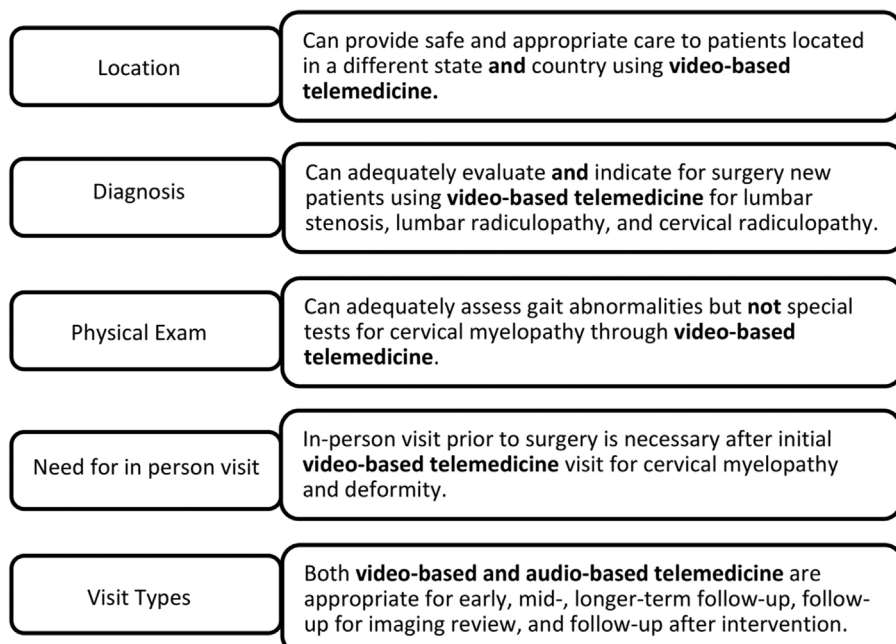


Figure 2. Summary of select consensus statements from various studied domains.

TABLE 3. Diagnoses Where a Positive or Negative Consensus was Reached Regarding Telemedicine for Video- and Audio-Based Visits

	Video-Based Telemedicine Visit		Audio-Based Telemedicine Visit	
	Adequately Evaluate New Patients	Indicate New Patients for Surgery	Adequately Evaluate New Patients	Indicate New Patients for Surgery
Lumbar stenosis	✓	✓	SA	
Lumbar radiculopathy	✓	✓		
Cervical myelopathy			✓	X
Cervical radiculopathy	✓	✓		
Deformity	SA		X	X

✓ (check mark) = positive consensus (i.e., ≥75% ACREE that video based visits allow for adequate evaluation of patients with lumbar stenosis); X = negative consensus (i.e., ≥75% DISAGREE that audio-based visits are sufficient to evaluate patients with cervical myelopathy); SA, strong agreement (66% ≤ AGREE ≤ 75%); blank = no consensus reached.

TABLE 4. Diagnoses Where a Positive or Negative Consensus was Reached Regarding Whether an In Person Visit Prior To Surgery was Considered "Best Practice" or Necessary

	In-Person Visit Prior To Surgery is Best Practice After Initial Video Telemedicine Evaluation	In-Person Visit Prior To Surgery is Necessary After Initial Video Telemedicine Evaluation
Lumbar stenosis	SA	
Lumbar radiculopathy	SA	
Cervical myelopathy	✓	✓
Cervical radiculopathy	✓	SA
Deformity	✓	✓

✓ (check mark) = positive consensus (i.e., ≥75% ACREE that it is best practice to see patients with cervical myelopathy in person prior to surgery); SA, strong agreement (66% ≤ AGREE ≤ 75%); blank = no consensus reached.

TABLE 5. Visit Types Where Audio- and Video-Based Visits May Be Appropriate

	Video-Based Telemedicine Visit	Audio-Based Telemedicine Visit
Early postoperative visit (2–6 weeks)	✓	✓
Mid-term postoperative visit (3–6 months)	✓	✓
Longer term postoperative visit (>6 months)	✓	✓
Postoperative wound issues	SA	X
Follow up visit for imaging review	✓	✓
Follow up visit after an intervention (e.g., injection or physical therapy)	✓	✓

✓ (check mark) = positive consensus (i.e., ≥75% ACREE that a video visit is adequate for an longer term postoperative visit); X = negative consensus (i.e., ≥75% DISAGREE that audio-based visits are adequate for evaluation of postoperative wound issues); SA, strong agreement (66% ≤ AGREE ≤ 75%); blank = no consensus reached.

for the application of telemedicine and provide several important areas for future investigation. Even though the consensus was from spine surgery experts, the results can be generalized to other areas of orthopedic surgery.

Impact of Patient Location

The expert panel of spine surgeons agreed that VT could be used to provide safe and effective care to patients located in different states and countries. As temporary mandates allowing the practice of telemedicine across state lines

discontinued, significant regulatory uncertainty has limited the ability of care to be provided due to geographical constraints.¹³ This has limited the ability of patients and providers to leverage some of the advantages of telemedicine.^{14,15}

Impact of Patient Diagnosis on Assessment of New Patients

This finding is particularly notable when viewed in conjunction with the positive consensus that patients with lumbar

stenosis, lumbar radiculopathy, and cervical radiculopathy could be adequately evaluated and indicated for surgery using a VT. Taken together, these diagnoses form a significant majority of the patients seen by most spine surgeons.¹⁶ This fact argues for a coordinated national strategy to regulate telemedicine rather than state-based regulation. Allowing broader access to VT may enable patients to more easily obtain second opinions and make more informed decisions about spine surgery; a ready availability of second opinions could greatly reduce the costs associated with spine care.¹⁷⁻¹⁹

Utility and Limitations of the Telemedicine Physical Examination

While providers express comfort evaluating and indicating patients for surgery through VT, there was considerably more disagreement about the remote physical examination. While consensus was achieved on two exams (positive consensus for evaluating gait abnormalities and negative consensus for performing special tests for cervical myelopathy on VT), there was no consensus achieved regarding the measurement of upper and lower extremity strength or the evaluation of neurologic deficits. In addition, there was no consensus on performing special tests for other evaluated diagnoses. Due to these findings, there is a need for research on standardized virtual examinations followed by validation of any special measurements involved.²⁰ A pilot trial performed for patients with degenerative spine conditions has suggested the possible utility of the virtual physical examination for spine surgery patients.²¹ While the virtual physical examination can be a powerful diagnostic tool, details from the expert panel delve into more detail surrounding which maneuvers for which diagnosis may be sufficiently reliable.

Need for In-Person Visits Prior to Surgery

While not necessarily required, most of the expert panel agreed that an in-person visit prior to surgery is “best practice” for most diagnoses. If patients are indicated for surgery, providers may wish to consider an in-person office visit prior to surgery when possible; this is a model already utilized by several practices - an initial new patient visit for evaluation/indication followed by a preoperative visit closer to the date of surgery to review questions. In this model, VT would seem to be an effective substitute for the initial in-person evaluation for most degenerative lumbar pathology and cervical radiculopathy. For cervical myelopathy and deformity, however, there was consensus that in-person visits were more than best practice - they were necessary prior to surgery.

Future research can help better delineate which patients benefit most from an in-person evaluation prior to surgery. It is possible that the in-person visit rarely changes the patient’s surgical plan or ultimate clinical outcome. Recent studies, for example, have shown that surgical plans generated from telemedicine visits are rarely changed after an in-person evaluation in spine patients.^{22,23} These studies as

retrospective reviews are valuable additions to the literature; however, they focused on small patient populations and showed that even outpatient spine surgical plans change nearly 10% of the time. It is possible that this frequency could underestimate how often surgical plans could change for spine surgeries that may be more complex and require inpatient admission. Further, these studies evaluated degenerative spine conditions and outpatient spine procedures in general. The expert panel sought to identify which specific diagnoses within spine surgery could be indicated for surgery without prior in-person evaluation, and also when in-person evaluation could be seen as best practice prior to surgery.

Acceptable Visit Types Using Telemedicine

With regards to visit types that are appropriate for telemedicine, the expert panel had positive consensus for early, mid-term, longer term postoperative follow-up, follow-up for imaging review, and follow-up after an intervention for both VT and AT. For postoperative wound issues, the panel had strong agreement that this visit type was appropriate for VT but negative consensus that this visit type was appropriate for AT. With up to 45% savings in direct costs associated with transitioning to telemedicine visits as oppose to traditional in-person visits, shifting certain appropriate visit types to VT would certainly help in reducing healthcare costs.²⁴ In addition, telemedicine visits, if used in the appropriate context, have been shown to be associated with both high satisfaction, improved access to care, and efficiency.²⁵⁻²⁷

It is also important to note that in addition to clinical guidelines, clarity on legal issues and regulations are also needed. Healthcare legal experts have previously outlined several important considerations that must be taken in legal and regulatory contexts in order to maximize the impact of telemedicine. These include important issues such as (1) establishing a uniform standard to obtain medical licenses for physicians who practice telemedicine in multiple jurisdictions, (2) clarifying reimbursement in order for providers to easily determine what types of telemedicine services private and public insurance policies will cover, and (3) enacting universal parity laws in order to reduce barriers to entry for hospital systems and providers to implement these services.²⁸

Strengths and Limitations

We acknowledge several limitations to the current work. First, the expert panel was comprised of only neurosurgeons and orthopedic spine surgeons. Although some of the consensus statements, such as appropriate visits for telemedicine, can be applied to other fields of orthopedic surgery, some are specific to spine surgery. In addition, the majority of the expert panel works in academic centers and tertiary referral centers, which may influence some of the determinations. However, we seek to emphasize that the current study was able to assemble a large group of key opinion leaders in the field of spine surgery and achieved diversity in

terms of years in practice, gender, and geographic location. The study also employed colleagues practicing outside of the United States to obtain additional perspectives. In addition, the consensus approach went through several iterations to ensure that consensus was viable.

CONCLUSION

In summary, an expert panel of spine surgeons had positive consensus that VT could be utilized regardless of patient location, is sufficient for evaluation and indication of surgery for multiple common spine pathologies, such as lumbar stenosis, lumbar radiculopathy, as well as cervical radiculopathy, and could be appropriate for a variety of visit types. However, there were still disagreements, including which physical exam maneuvers were appropriate for VT and whether or not an in-person visit was necessary after patients are indicated for certain diagnoses (lumbar stenosis, lumbar radiculopathy, and cervical radiculopathy). Although more data on guidelines and criteria for appropriate telemedicine use are still needed, the current study helps elaborate optimal conditions and criteria for implementation of telemedicine in the evaluation of patients with spine conditions.

➤ Key Points

- Video based telemedicine can be used to evaluate patients with lumbar stenosis, lumbar radiculopathy, and cervical radiculopathy and indicate them for surgery.
- Video based telemedicine was the preferred method of evaluating new patients
- Video or audio visits were deemed sufficient for most routine follow up visits with the exception of wound checks.
- In patients indicated for surgery via telemedicine, in person visits prior to surgery were generally considered *best practice*; however, they were only noted to be necessary for the diagnosis of cervical myelopathy and deformity.
- The panel had consensus that video visits could be utilized regardless of patient location

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